FUTURE DIRECTIONS IN SIMULATION OUTPUT ANALYSIS METHODOLOGY

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ABSTRACT

Simulation is an established tool that allows the study and analysis of complex systems. New output analysis methodologies have emerged that promise to make radical advances affecting how simulation will influence system design and operation. These methodologies will provide powerful tools allowing product and process engineers to develop very good system-level designs that satisfy many competing requirements to include technical, schedule, and cost. These methodologies will also guide engineers to perform statistically valid simulation experiments and provide assistance to interpretation of experimental data.

Simulation optimization is a key output analysis methodology that is rapidly becoming a mainstream tool for simulation practitioners. Simulation optimization is the practice of linking an optimization method with a simulation model to determine appropriate settings of certain input parameters so as to maximize the performance of the simulated system. Requirements for an automated simulation optimization tool for practitioners were formulated in the early 1970s and the first widely used commercial product appeared in 1995. In this paper, the authors identify six domains that are common to any automated simulation optimization tool: Methods, Classification, Strategy and Tactics, Intelligence, Interfaces, and Problem Formulation. These domains are the cornerstones for a unified strategy for simulation optimization and should guide future research in the field and development of next generation simulation optimization tools. The authors describe recent research and present an application of simulation optimization to an industrial problem.

Other output analysis methodologies that promise to enhance the system design process include statistical factor screening techniques and ranking and selection techniques. Factor screening allows the system designer to identify factors that do not significantly influence system performance with respect to the several requirements. This would be helpful to the design optimization process because eliminating input factors reduces the size of the search space (number of possible solutions), which makes the problem easier to solve. Statistical ranking and selection techniques (RST) can be used during the optimization process or at the end of the optimization. During the optimization process, RST can possibly help to ensure that optimization algorithms identify the "truly" better design solutions over the course of the search. That is, RST may help keep the optimization algorithm from being misled by the variation in the output. RST can be used at the end of the optimization process with the goal of identifying the best design solution from the top solutions found by an optimizer. Future research and development will produce automated tools that will allow systems designers to adapt and use these methodologies with their simulations and then to properly interpret the output with respect to overall system design. The authors describe recent research in applying various output analysis methodologies to enhance simulation-based design decisions.

The authors also describe methodologies to guide the engineers to perform statistically valid simulation experiments. For example, automated tools are being examined to determine the end of the warm-up period for non-terminating simulations. This is necessary because the length of the warm-up period for a model can change as an optimizer changes the values of input factors.